

Appl. No. 10/821,432
Reply to Final Office Action of February 13, 2006

Attorney Docket No. 2003-0893/24061.148
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Amendments to the Drawings

Applicant has corrected the title of each of the drawings and amended Figures 2 and 3. Replacement Sheets are attached.

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Remarks:

Claims 1-54 were previously pending in this application, of which claims 4, 10, 21, 27, 37, 42 and 53 have been amended, claims 1, 13, 18, 30, 35 and 45 have been canceled, claims 11-12, 20, 28-29, 33, 43-44, and 48 have been maintained in their original form, and claims 2-3, 5-9, 14-17, 19, 22-26, 31-32, 34, 36, 38-41, 46-47, 49-52 and 54 were previously presented. Reconsideration of presently pending claims 2-12, 14-17, 19-29, 31-34, 36-44 and 46-54 is respectfully requested in light of the following amendments and remarks.

Objection to the Drawings

The title of each of the drawings has been corrected per the Examiner's suggestion. Figures 2 and 3 have been resubmitted with hatching per the Examiner's suggestion. Additionally, in Figure 3, reference numeral "140" has been amended to "142," reference numeral "142" has been amended to "144," and reference numeral "144" has been amended to "146." Figure 3 has been amended to be consistent with Figure 2 and the description in the Specification. No new matter has been added.

Allowable Subject Matter

Noted with appreciation is the indication in the Office Action that claims 10-12, 27-29, and 42-44 are directed to allowable subject matter, and would be allowed if rewritten in independent form. Claims 10, 27, and 42 have been rewritten in independent form and are now in condition for allowance. Claims 11-12 depend from and further limit claim 10 and are allowable as well. Claims 28-29 depend from and further limit claim 27 and are allowable as well. Claims 43-44 depend from and further limit claim 42 and are allowable as well.

Rejections under 35 U.S.C. § 112

Claim 53 was rejected under 35 U.S.C. § 112 as being indefinite. Claim 53 has been amended to recite "...a width of the source perpendicular to the first edge of the source."

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(Emphasis added). Thus, amended claim 53 is no longer indefinite and the rejection should be withdrawn.

Rejections under 35 U.S.C. § 102

Independent Claim 4

Claim 4 recites:

A semiconductor device comprising: a substrate including a source and drain, the source having a first edge and the drain having a first edge; a body contact feature adjacent to the source; a gate between the source and drain, the gate having a first portion; and a first deep trench structure located directly under the first portion of the gate viewed in a direction from the gate to the substrate, and proximate to the first edge of the source and the first edge of the drain, wherein the first deep trench structure has a depth greater than 0.5 μm .

Claim 4 was rejected under 35 U.S.C. § 102(b) as being anticipated by Joyner et al. (U.S. Patent No. 6,114,741 hereinafter referred to as "Joyner"). MPEP §2131 provides that, "[t]o anticipate a claim, the reference must teach every element of the claim." Therefore, to support this rejection with respect to claim 4 the Joyner patent must contain all of the above-claimed elements of the claim. However, Joyner does not teach "a first deep trench structure located directly under the first portion of the gate viewed in a direction from the gate to the substrate, and proximate to the first edge of the source and the first edge of the drain, wherein the first deep trench structure has a depth greater than 0.5 μm ," and "a body contact feature adjacent to the source," as recited in claim 4. (Emphasis added) (See Present Application, Figs. 1 & 3). Instead, Joyner teaches a trench region (22) that lies between gate structures (26) of the two active regions (12, 14). (See Joyner, Figs. 2 & 3).

Additionally, as indicated in the Office Action, Joyner discloses that "[t]he depth of the trench region may be virtually any depth to produce isolation between active region 12 and active

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region 14.” (See Office Action, pg. 5, par. 5). However, Joyner further discloses that “shallow trench isolation (“STI”) techniques will generally result in a trench region with a shallower depth.... the trench region may be provided at a depth of around 0.5 microns or less.” (See Joyner, col. 3, lines 45–48). In contrast, claim 4 recites “wherein the first deep trench structure has a depth greater than 0.5 μm .”

Therefore, the rejection of claim 4 under 35 U.S.C. § 102 cannot be supported by the Joyner reference and should be withdrawn.

Claim 4 was rejected under 35 U.S.C. § 102(e) as being anticipated by Hara et al. (U.S. Patent Publication 2004/0029355 hereinafter referred to as “Hara”). MPEP §2131 provides that, “[t]o anticipate a claim, the reference must teach every element of the claim.” Therefore, to support this rejection with respect to claim 4 the Hara reference must contain all of the above-claimed elements of the claim. However, Hara does not teach “a first deep trench structure located directly under the first portion of the gate viewed in a direction from the gate to the substrate,” and “a body contact feature adjacent to the source,” as recited in claim 4. (Emphasis added) (See Present Application, Figs. 1 & 3). Instead, Hara teaches a trench structure (7) that is located adjacent to the gate structure (12) but not directly under a first portion of the gate. (See Hara, Fig. 4A & 4B). Moreover, no where in Hara does it teach “a body contact feature adjacent to the source.”

Therefore, the rejection of claim 4 under 35 U.S.C. § 102 cannot be supported by the Hara reference and should be withdrawn.

Independent Claim 21

Claim 21 was rejected under 35 U.S.C. § 102(b) as being anticipated by Joyner. Claim 21 is allowable for the same reasons set forth above for claim 4. Therefore, the rejection of claim 21 under 35 U.S.C. § 102 cannot be supported by the Joyner reference and should be withdrawn.

Claim 21 was rejected under 35 U.S.C. § 102(e) as being anticipated by Hara. Claim 21 is allowable for the same reasons set forth above for claim 4. Therefore, the rejection of claim 21

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under 35 U.S.C. § 102 cannot be supported by the Hara reference and should be withdrawn.

Independent Claim 37

Claim 37 recites:

A semiconductor device comprising: a substrate having a source and drain, having widths that are substantially equal and each having a first edge substantially located along a common line on the substrate; a body contact feature adjacent to the source; a gate electrode on the substrate and between the source and the drain, the gate electrode having a first portion extending past the first edge of the source and the first edge of the drain; and a first deep trench structure located directly under the first portion of the gate electrode viewed in a direction from the gate electrode to the substrate, the first deep trench structure parallel to the common line on the substrate and proximate to the first edge of the source and the first edge of the drain, wherein the first deep trench structure is substantially deeper than 0.5 μm

Claim 37 was rejected under 35 U.S.C. § 102(b) as being anticipated by Joyner. Claim 37 is allowable for the same reasons set forth above for claim 4. Therefore, the rejection of claim 37 under 35 U.S.C. § 102 cannot be supported by the Joyner reference and should be withdrawn.

Claim 37 was rejected under 35 U.S.C. § 102(e) as being anticipated by Hara. Claim 37 is allowable for at least the same reasons set forth above for claim 4. Additionally, Hara does not teach that “the first deep trench structure [is] parallel to the common line on the substrate,” as recited in claim 37. (Emphasis added). The common line (126) on the substrate represents the line formed by the first edge of the source (114) and drain (124). (See Present Application, par. [0021]; Figs. 1 & 3). In contrast, Hara teaches a trench region (7) that is perpendicular to the line formed by the first edge of the source and drain. (See Hara, Figs. 4A & 4B). Therefore, the rejection of claim 37 under 35 U.S.C. § 102 cannot be supported by the Hara reference and should be withdrawn.

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Independent Claim 50

Claim 50 recites:

A semiconductor device comprising: a substrate including a first well of a first-type dopant and a second well of a second type dopant, the first well being disposed laterally adjacent the second well; a source formed in the first well and drain formed in the second well, the source having a first edge and the drain having a first edge; a gate electrode on the substrate and between the source and drain, a first portion of the gate electrode extending past the first edge of the source and the first edge of the drain; a current channel located in a region where the gate electrode extends beyond the first edge of the source and the first edge of the drain, the current channel allowing a leakage current to flow in the device; and a first deep trench structure formed partially in the first well and partially in the second well, located under the first portion of the gate electrode and proximate to the first edge of the source and the first edge of the drain, whereby the first deep trench structure is located close enough to the first edge of the source and the first edge of the drain to substantially eliminate the leakage current flow through the current channel.

Claim 50 was rejected under 35 U.S.C. § 102(b) as being anticipated by Brand (U.S. Patent No. 6,172,401). MPEP §2131 provides that, "[t]o anticipate a claim, the reference must teach every element of the claim." Therefore, to support this rejection with respect to claim 50 the Brand patent must contain all of the above-claimed elements of the claim. However, Brand does not teach "a first deep trench structure formed partially in the first well and partially in the second well, located under the first portion of the gate electrode and proximate to the first edge of the source and the first edge of the drain," as recited in claim 50. Instead, Brand teaches forming multiple STI structures (110 next to 155 and 110 next to 160) which may be used to define discreet active areas or cell regions, for example N-type and P-type regions...." (See Brand, col. 4, lines 41-43; Fig. 7 & 8). Furthermore, the only trench structure shown in Brand (110 next to 160 of Fig. 7) that is formed partially in the first well and partially in the second well

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is not "located under the first portion of the gate and proximate to the first edge of the source and the first edge of the drain." The Present Application teaches a first deep trench structure (152) that is formed partially in the first well (104) and partially in the second well (106) which is located under the first portion of the gate and proximate to the first edge (114) of the source (108) and the first edge (124) of the drain (120). (See Present Application, Figs. 1 & 3). Thus, the rejection of claim 50 under 35 U.S.C. § 102 cannot be supported by the Brand reference and should be withdrawn.

Independent Claim 51

Claim 51 was rejected under 35 U.S.C. § 102(b) as being anticipated by Brand. Claim 51 is allowable for the same reasons as set forth above for claim 50. Therefore, the rejection of claim 51 under 35 U.S.C. § 102 cannot be supported by the Brand reference and should be withdrawn.

Independent Claim 52

Claim 52 recites:

A semiconductor device comprising: a substrate including a first well of a first type dopant and a second well of a second type dopant; a source disposed in the first well and a drain disposed in the second well, the source having a first edge and the drain having a first edge; a gate electrode between the source and drain; and a deep trench structure located directly under the gate electrode, and proximate to the first edge of the source and the first edge of the drain.

Claim 52 was rejected under 35 U.S.C. § 102(b) as being anticipated by Brand. MPEP §2131 provides that, "[t]o anticipate a claim, the reference must teach every element of the claim." Therefore, to support this rejection with respect to claim 50 the Brand patent must contain all of the above-claimed elements of the claim. However, Brand does not teach "a deep

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trench structure located directly under the gate electrode, and proximate to the first edge of the source and the first edge of the drain.” (Emphasis added). Instead, Brand teaches trench structures (110, 115) that are located on either side of the gate structure (145) and not directly under. (See Brand, Fig. 7). Furthermore, none of the trench structures shown in Brand (110, 115 of Fig. 7) are “located directly under the gate electrode, and proximate to the first edge of the source and the first edge of the drain.” (Emphasis added).

Additionally, claim 53, which depends from and further limits claim 52, was rejected under 35 U.S.C. § 102(b) as being anticipated by Brand. Claim 53 recites “wherein the deep trench is proximate to the first edge of the source and the first edge of the drain with a smaller distance relative to a width of the source perpendicular to the first edge of the source.” As admitted in the Office Action, “Brand teaches distance W_2 is equal to zero.” (See Office Action, pg. 12, par. 7). However, claim 53 recites “a smaller distance relative to a width of the source” which clearly defines a finite distance between the deep trench and the first edge of the source and drain. (See Present Application, Fig. 1). Since Brand teaches a distance equal to zero which is not a finite distance, Brand does not teach “wherein the deep trench is proximate to the first edge of the source and the first edge of the drain with a smaller distance relative to a width of the source perpendicular to the first edge of the source.” (Emphasis added).

Therefore, the rejection of claims 52 and 53 under 35 U.S.C. § 102 cannot be supported by the Brand reference and should be withdrawn.

Rejections under 35 U.S.C. § 103

Independent Claim 4

Claim 4 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Kuroi et al. (U.S. Patent Publication 2002/0038901 hereinafter referred to as “Kuroi”) in view of Chen et al. (U.S. Patent Publication 2003/0006476 hereinafter referred to as “Chen”). Applicant traverses this rejection on the grounds that these references are defective in establishing a *prima facie* case of obviousness with respect to amended claim 4.

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Under MPEP § 2142, “[i]f the examiner does not produce a *prima facie* case, the applicant is under no obligation to submit evidence of nonobviousness.” It is submitted that, in the present case, the Examiner has not factually supported a *prima facie* case of obviousness for the following, mutually exclusive, reasons.

When evaluating a claim for determining obviousness, all limitations of the claim must be evaluated. However, Kuroi and Chen, alone, or in combination, do not teach “a body contact feature adjacent to the source,” as recited in amended claim 4. As a result, the Examiner’s burden of factually supporting a *prima facie* case of obviousness clearly cannot be met with respect to claim 4, and the rejection under 35 U.S.C. §103 should be withdrawn.

Claim 4 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Shima et al. (U.S. Patent Publication 2003/0155592 hereinafter referred to as “Shima”) in further view of Chen. Applicant traverses this rejection on the grounds that these references are defective in establishing a *prima facie* case of obviousness with respect to claim 4.

Under MPEP § 2142, “[i]f the examiner does not produce a *prima facie* case, the applicant is under no obligation to submit evidence of nonobviousness.” It is submitted that, in the present case, the Examiner has not factually supported a *prima facie* case of obviousness for the following reason.

When evaluating a claim for determining obviousness, all limitations of the claim must be evaluated. However, Shima and Chen, alone, or in combination, do not teach “a first deep trench structure located directly under the first portion of the gate viewed in a direction from the gate to the substrate, and proximate to the first edge of the source and the first edge of the drain.” (Emphasis added). As stated in the Office Action, Shima teaches “a first deep trench structure [FIG. 10, 11H, 12; 32] located directly [see FIG. 12] under the first portion....” (See Office Action, pg. 19, par. 9). Applicant respectfully traverses this assertion. In fact, Shima teaches that “the isolation structure 32 is formed by shallow trench isolation (STI) in the semiconductor layer structure of FIG. 11A, so that the p-channel MOS region 31A and the n-channel MOS region 31B are formed isolated from each other in the Si substrate 31.” (Emphasis added) (See

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Shima, par. [0078]). As such, Shima shows a STI (32) structure that is located on the left hand side of the p-channel MOS region (31A), on the right hand side of the n-channel MOS region (31B), and in between the p-channel and n-channel MOS regions. (See Shima, FIGS. 10 & 12). Thus, Shima does not teach "a first deep trench structure located directly under the first portion of the gate viewed in a direction from the gate to the substrate, and proximate to the first edge of the source and the first edge of the drain," as recited in claim 4. (Emphasis added).

As a result, the Examiner's burden of factually supporting a *prima facie* case of obviousness clearly cannot be met with respect to claim 4, and the rejection under 35 U.S.C. §103 should be withdrawn.

Independent Claim 21

Claim 21 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Kuroi in further view of Chen. Claim 21 is allowable for the same reasons as set forth above for claim 4.

Claim 21 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Shima in further view of Chen. Claim 21 is allowable for the same reasons as set forth above for claim 4.

Independent Claim 37

Claim 37 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Kuroi in view of Chen. Claim 37 is allowable for the same reasons as set forth above for claim 4.

Claim 37 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Shima in further view of Chen. Claim 37 is allowable for the same reasons as set forth above for claim 4.

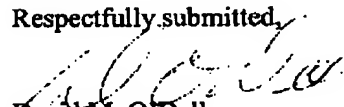
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The Examiner is invited to call the undersigned at the below-listed phone number if a telephone conference would expedite or aid the prosecution and examination of this Application. Deposit account 08-1394 can be used, as required.

An early formal notice of allowance of claims 2-12, 14-17, 19-29, 31-34, 36-44 and 46-54 is requested.

Respectfully submitted,


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